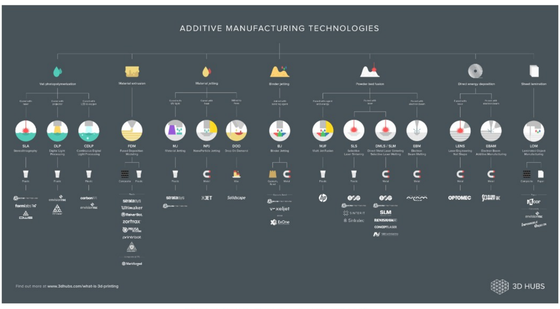
Key design considerations for 3D Printing

Written by Robin Brockotter

A list of things to keep in mind when designing a model for 3D printing - regardless of the technology that you will be printing with.

Introduction

There is a large variety of different 3D printing technologies which all have specific design rules to keep in mind and adhere to. This article only discusses the design aspects that apply to all of them.



Click here for an enlarged version of the infographic.

This article assumes that you are already know a bit about 3D designing/modelling. The design software you use to create your models won't matter though. If you are completely new to 3D modelling, there are many excellent programs to introduce beginners to 3D modelling that also offer a strong line of video tutorials to help you understand the basics of 3D design.

Printability

The most important thing to keep in mind when designing for 3D printing is the fact that the process will be turning a digital design into something real. In a design environment, there are no laws of physics to adhere to such as gravity or the expanding/shrinking of the material you want to print in.

Overhang

An overhang is where the printed layer of material is only partially supported by the layer below or not supported at all. All printer technologies are based on an additive process, with the layer about to be printed requiring a layer below it to adhere to (with the exceptions of SLS and Binder Jetting). There are limits that printers can print up to, 45 degrees for FDM, beyond which support material is needed to support overhangs and allow them to be printed accurately.

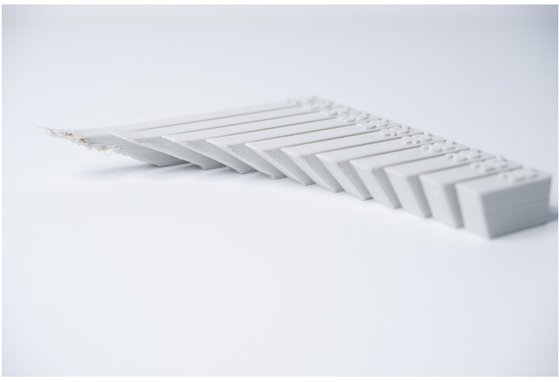


Image showing the effect of increasing angle on overhang quality for FDM printing

Wall thickness

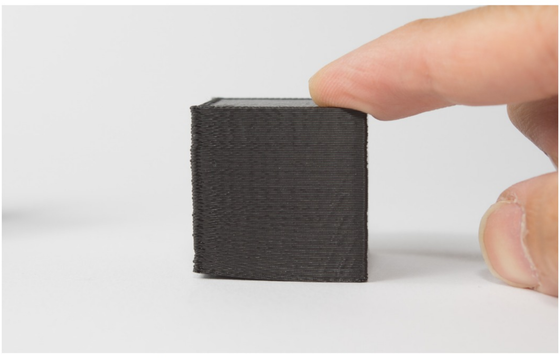
The second thing to keep in mind when designing a part to be 3D printed is wall thickness. In order to print layer upon layer, it's necessary to have a minimum wall thickness, depending on the 3D printing technique that you use.

For example, imagine you are an engineer who designs hang-gliders for a living. You have come up with a great, new design that you have decided to 3D print at a small scale to test. 3D modelling programs may allow you to model the sail cloth of the wings of your hang-glider, but they will have an infinitesimally small thickness and will be unprintable when transferred to a 3D printer.

Warping

Something often easily overlooked is the fact that in order to 3D print, 3D printing techniques such as SLS and FDM, rely on heating up the material to over 200 ℃ to either melt or sinter material. The heating up and cooling down of material can cause some warping of the 3D print.

Long, flat surfaces can be especially prone to warping. Warping can typically be avoided by using correct machine calibration and having adequate surface adhesion between your part and the print bed. Your Hub will be able to offer more advice on design techniques that can be used to minimize the likelihood of warping occurring.



Black ABS in 200 micron showing warping of the bottom left corner.

Details

When you're creating a design with intricate details, it's important to know whether or not the details will even show up in the final print. FDM will generally struggle to clearly show features below 0.8mm, whereas SLA and Polyjet is more suited for applications where these smaller features are important (down to 0.2mm).

The process and materials used will have an impact on the speed and cost of your print, so determining whether smaller details are critical to the design is an important design decision.

Marvin printed in 200 microns FDM, 100 microns FDM, SLA and Polyjet (left to right)

Written by

Robin Brockotter
for 3D Hubs – 3D Character Artist with history in Game Design.